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A New Species of *Flabellina* (Nudibranchia: Aeolidacea) from Oshoro Bay, Japan

by

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Abstract. *Flabellina* ***amabilis*** sp. nov. from Oshoro Bay, western Hokkaido, Japan, is described and illustrated. The living animal can be distinguished easily from closely related species by the particular patterns of white coloration on the body, the morphology of the foot corners, the ceratal arrangement, the position of the anus and gonopore, and the unique shape of its penis.

INTRODUCTION

During the course of an ecological survey on *Flabellina athadona* (Bergh, 1875) at Oshoro Bay (Sea of Japan), western Hokkaido (see map, HIRANO & HIRANO, 1985), a new and closely related species also belonging to the Flabellinidae was found during the same season. This paper describes the external and internal morphology of this new species and compares it with closely allied congeners. All descriptions are based upon living animals because the discrimination between this species and *F. athadona* is especially difficult after preservation. Although we have examined hundreds of specimens, only specimens selected for the type series are described and figured.

DESCRIPTION

Flabellina ***amabilis*** Hirano & Kuzirian, sp. nov.

(Figures 1–7)

Type material: Holotype, National Science Museum of Tokyo (catalogue number NSMT-MO66330), specimen collected 26 February 1985, Oshoro Bay, Hokkaido, Japan. Ten paratypes, NSMT-MO66331, from the same sample; color transparencies also on file.

Distribution and habitat: Despite the fact that various localities in Hokkaido and Honshu, mainland Japan, have been sampled, this species has been found only at Oshoro Bay, western Hokkaido. Specimens were found on athecate hydroid colonies of *Eudendrium boreale* Yamada, 1954, attached to intertidal or subtidal rocky substrates.

Etymology: This species is named for its charming appearance and countenance when seen alive and in its natural habitat. The Japanese name "Pirika-minoumiushi" is assigned: "pirika" means pretty or beautiful in the Ainu (the language of Ainu) and "minoumiushi" means aeolid nudibranch in Japanese.

External morphology: Body translucent white, with pale orange or salmon pink viscera. Diverticula of digestive gland within cerata reddish orange, carmine, or sometimes tan to dark brown. Opaque white specks on dorsal surfaces of tips of oral tentacles, and entire distal half of rhinophores; basally, white coloration only on dorsal surface of rhinophores. Cerata with opaque white dots or flecks occurring sparsely around distal half of ceratal surfaces, seldom found on lower half. Similar opaque white flecks restricted to central line on dorsal tail surface; not found on any other dorsal body surface (Figures 1, 2A).

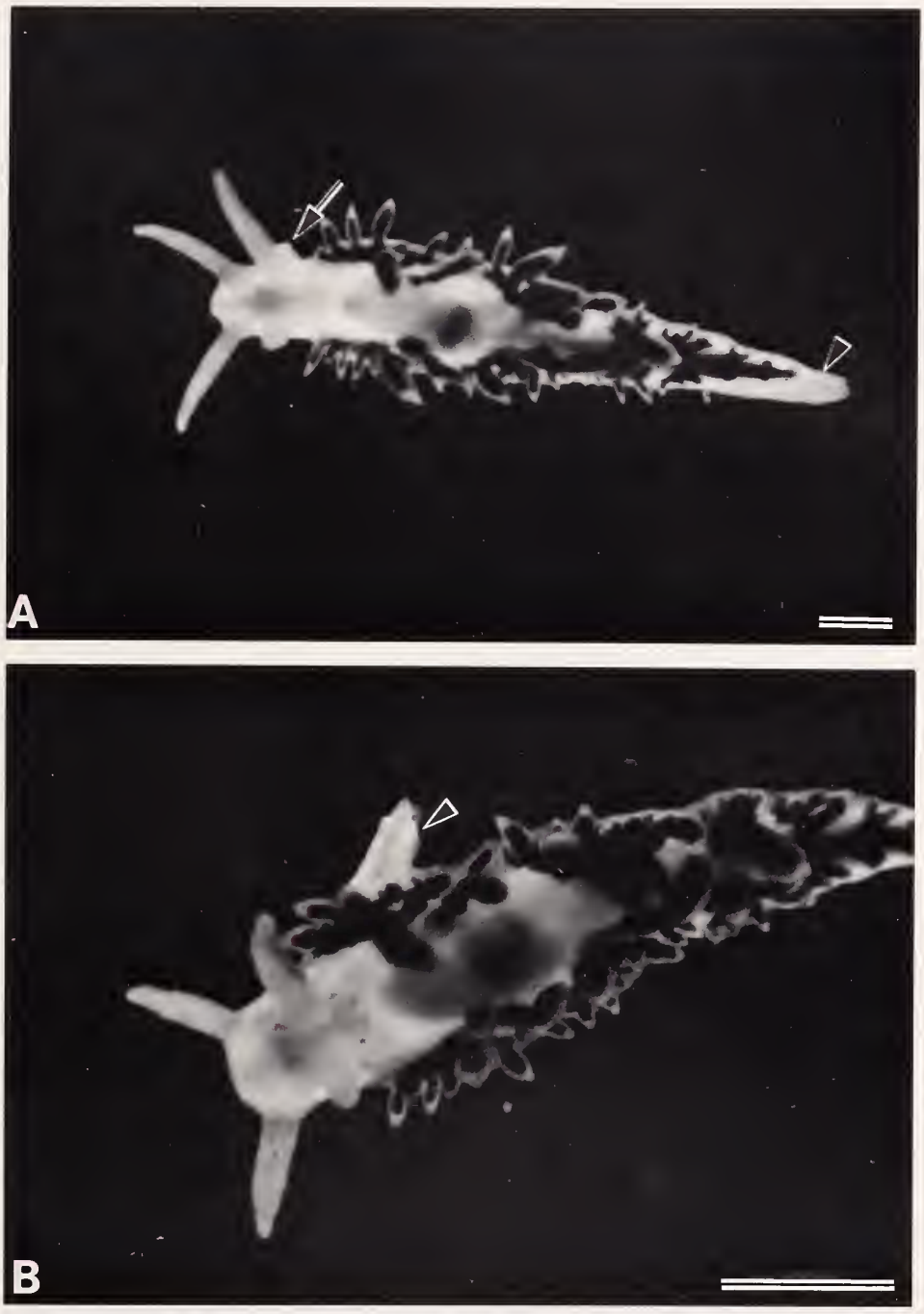

Figure 1

Flabellina ***amabilis*** Hirano & Kuzirian, sp. nov. A. Dorsal view of live animal, illustrating short, pointed anterior foot corners (arrow) and opaque white stripe occurring on tail only (arrowhead). B. Dorsal view of another animal with its long, conical penis everted (scales = 3.0 mm).

Extended body length to 26 mm. Body long, high, but not very narrow in comparison of width-to-length proportions. Notal brim prominent and continuous; pericardium situated between one-half and one-third of body length from anterior end; tail approximately one-fifth to one-seventh of body length.

Foot equaling width of visceral portion of body, lateral margin flared, undulate, extending with long gentle taper

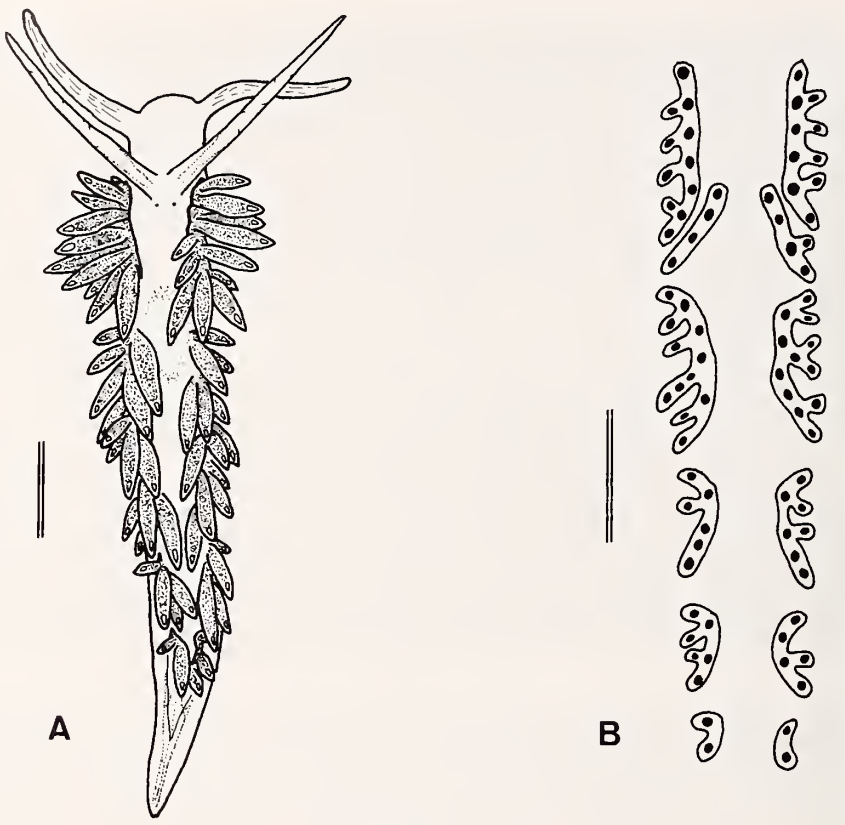

Figure 2

Flabellina ***amabilis***. A. Diagrammatic illustration of 15-mm-long animal, depicting general body form, ceratal arrangement, and patterns of opaque white body coloration on oral tentacles, rhinophores, and tail. B. Schematic diagram of ceratal clusters and branching patterns (scales = 2.0 mm).

to pointed tail; anterior foot margin with transverse labial groove, slightly notched medially; anterior foot corners only slightly pointed, not tentaculiform and difficult to distinguish in preserved material (Figure 3).

Oral tentacles about one-fifth to one-sixth of body length, tapering gradually to rounded tip. Rhinophores slightly longer and narrower than oral tentacles, moderately tapered to bluntly tipped. Oral tentacles with smooth surface; rhinophores slightly verrucose.

Cerata arranged in five to six clusters; most posterior cluster difficult to distinguish bilaterally. First and second cluster with five to six loosely defined rows, remainder with three to four rows (Figure 2B); lateral cerata lining notal brim very small, medial ones longest. Each fully developed ceras fusiform, lanceolate to linear in outline; cnidosac prominent, ovoid or conical.

Interhepatic space small. Anus pleuroproctic, lying below third or fourth ceratal row of second cluster, just ventral to notum. Renal pore clearly visible and situated within 1 mm anterior to anus and slightly more dorsal. Gonopore located beneath anterior to middle of first ceratal cluster (Figure 3).

Buccal cavity: Jaws ovoid with prominent masticatory border bearing 5 or 6 rows of distinct denticles (Figure 4). Oral glands absent; pair of typical, elongate salivary glands present with ducts passing through circumoesophageal nervous system and entering buccal mass on each side of oesophagus. Radula triseriate, formula equals 13–17 × 1·1·1. Rachidian tooth with 5–7 denticles bilaterally, denticles slightly curved toward large central cusp. Lateral teeth sickle-shaped with 6–8 denticles on inner side (Figure 5).

Reproductive system: System androdiaulic (Figures 6, 7; especially see Figure 7 for a functional description of the reproductive system). Gonad large, pale orange to salmon pink; follicles tightly packed with moderately small, female acini peripherally. Pre-ampullary duct runs centrally within gonad, along right side of main posterior ceratal duct; duct expands into ampulla of only one loop from which emerges narrow post-ampullary duct, lying below bursa and within folds of mucous gland. Distally, duct divides into oviduct and prostatic vas deferens. Proximal oviduct loops posteriorly and expands into large bulbous

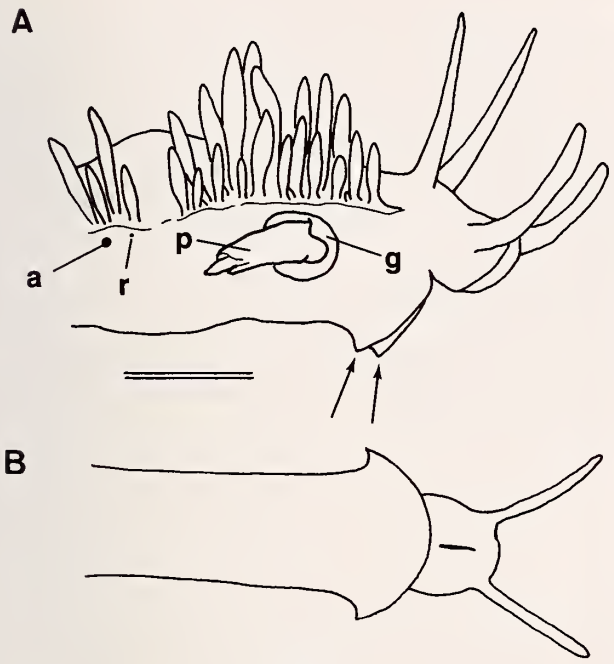

Figure 3

Flabellina ***amabilis***. A. Sketch of animal's anterior right side illustrating positions of anus (a), renopore (r), common gonopore (g) with everted conical penis (p), and short, pointed anterior foot corners (arrows) (scale = 2.0 mm). B. Ventral view of the animal.

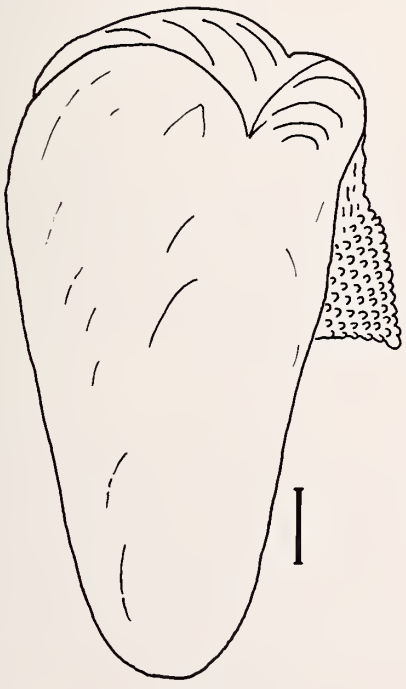

Figure 4

Flabellina ***amabilis***. Diagram of single jaw plate with denticulate masticatory border (scale = 120 μm).

Figure 5

Flabellina ***amabilis***. Scanning electron microscopic image of three complete radular teeth rows, illustrating central rachidian and lateral (2) tooth morphology (scale = 20 μm).

serial receptaculum seminis, which continues anteriorly as distal oviduct and enters albumen gland. Prostatic vas deferens long, smooth, muscular, consisting of 4 or 5 tightly coiled loops; distally tapers into small preputium. Penis long, thin, unarmed with sharply pointed tip surrounded by thin membranous sheath (Figure 1B). Nidamental and penial apertures contained in common external gonopore. Bursa copulatrix bulbous with long narrow duct inserting dorsally into nidamental duct, just internal to gonopore.

Reproductive cycle: Spawning with large numbers of egg masses has been observed yearly during the winter season (late December–early April) at Oshoro Bay from 1983 to 1988. The egg mass consists of a thin undulate coil (type B; HURST, 1967) containing singly encapsulated eggs measuring 60–65 μm in diameter. The capsule itself is oval and measures 90–100 μm long by 70–85 μm wide. Embryos develop into planktotrophic veligers with spiralled, type I shells (THOMPSON, 1961).

DISCUSSION

GOSLINER & GRIFFITHS (1981) regarded *Coryphella* Gray, 1850, as a junior subjective synonym of *Flabellina* Voigt, 1834, on the basis of priority, after comparing the simi-

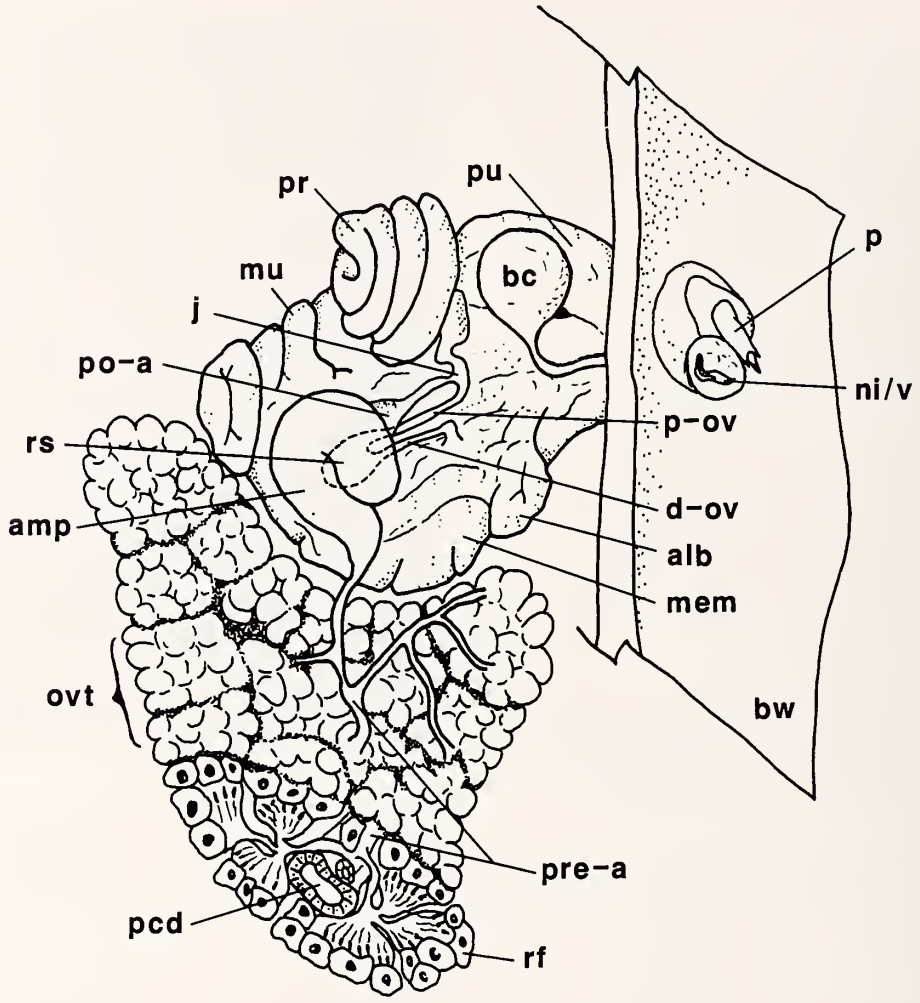

Figure 6

Flabellina ***amabilis***. Diagram of reproductive system depicting configuration and placement of major components: alb, albumen gland; amp, ampulla; bc, bursa copulatrix; bw, portion of external body wall; d-ov, distal oviduct; j, junctional separation of male and female pallial gonoducts; mem, membrane gland; mu, mucous gland; ni/v, nidamental/vaginal opening; ovt, ovotestis; p, conical penis; pcd, posterior ceratal duct; po-a, post-ampullary duct; p-ov, proximal oviduct; pr, prostatic vas deferens; pre-a, pre-ampullary duct; pu, preputium; rf, cross-section of reproductive follicle illustrating peripherally developing oocytes, medially developing sperm, and small basal ductule emptying each follicle into pre-ampullary duct; rs, receptaculum seminis.

larities and differences between the two genera. The taxon *Flabellina,* as it now stands, comprises a widely divergent and ponderous assemblage of species, especially when one considers the extremes in plesiomorphic and derived characters. However, if the taxon is analyzed by species, there is a continuum of overlapping character states throughout. Therefore, we have tentatively accepted this taxonomic change, but realize that the synonymy has not gained universal acceptance.

Flabellina ***amabilis*** sp. nov. can be distinguished from its congeners reported from the Sea of Japan and Pacific coasts of Japan on the basis of numerous morphologic characters (Table 1). When compared with living specimens of *F. abei* (Baba, 1987a), *F.* ***amabilis*** can be identified by the presence of an opaque white line on the tail only and dorsal surfaces of the tips of the oral tentacles. The head of *F. abei* has a bold, opaque-white letter "Y" in the center, while the oral tentacles bear a white line along the posterior surface. *Flabellina abei* also possesses a common genital atrium with the gonopore located on the right side below the center of the first ceratal cluster, and the anus is located at the posterior edge of the interhepatic space below the first row of cerata of the second cluster. In contrast, *F.* ***amabilis*** has no genital atrium and the com-

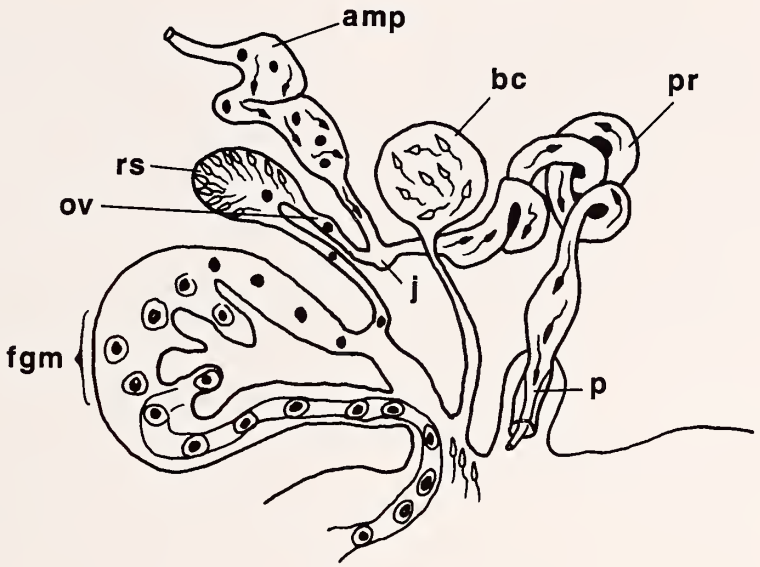

Figure 7

Flabellina ***amabilis***. Schematic representation of distal gland mass of reproductive system, depicting major components with their function: endogenous sperm (solid sperm heads) and oocytes (solid circles) in arrested metaphase traverse the ampulla (amp) to junction (j) where male and female pallial gonoducts separate; oocytes travel through oviduct (ov), receptaculum seminis (rs) where exogenous sperm (open sperm heads) are stored embedded within lining epithelium and fertilization putatively occurs, then into female gland mass (fgm) where eggs are encapsulated and collated into egg ribbon before exiting via nidamental opening; endogenous sperm travel through prostatic vas deferens (pr) and during copulation are deposited by penis (p) into female vaginal opening (common with nidamental opening in this species); these now exogenous sperm are initially received in bursa copulatrix (bc) which dissolves prostatic secretions, thus allowing sperm to move into receptaculum seminis (rs) for nourishment and storage.

Table 1

Morphologic characters of major Japanese species of *Flabellina*.

Character state	*F. amabilis*	*F. abei*	*F. athadona*
White coloration			
Body	tail stripe only	head only; letter "Y"	Y-shaped, dorsal stripe; tip oral tentacles to tail
Oral tentacles	speckled	stripe; posterior edge	stripe; as above
Cerata	speckled tips	speckled, white tips	speckled
Ceratal arrangement	5–6 clusters; 3–6 rows/cluster	5 clusters	6 clusters; 5–6 rows/cluster
Notum	distinct	distinct	distinct; less interhepatic space
Foot corners	small, pointed	long, tentacular	rounded
Anal position, 2nd ceratal cluster	row 3–4	row 1	row 3
Gonopore, 1st ceratal cluster	anterior half	center	anterior half
Genital atrium (common)	absent	present	present; vestibular glands
Penis	conical	conical	"false"†
Radular formula	13–17 × 1·1·1	15 × 1·1·1	19–22 × 1·1·1
Denticulation			
Rachidian teeth	6–9	6–9	4–5
Lateral teeth	6–8	11–12	8–9
Central cusp of rachidian	long, wide	long, thin	short, wide

† Baba (1987b).

mon gonopore bearing the separate penial and nidamental openings is located beneath the anterior half of the first ceratal cluster. The color pattern of the other closely related species, *F. athadona* (Bergh, 1875), which has been described from living animals (Baba, 1987b), consists of a Y-shaped mid-dorsal white stripe extending from the tips of the oral tentacles to the tail. The gonopore of *F. athadona,* as diagrammed by Baba (1987b), serves as the opening for a common genital atrium and is located below the anterior half of the anterior right ceratal cluster. The anus of this species and of *F.* ***amabilis*** is similarly located beneath the third row of cerata of the second cluster. All three species can also be distinguished from each other using the morphology of the anterior foot corner. *Flabellina abei* has long, tentacular foot corners, while in *F.* ***amabilis*** they are only slightly pointed; *F. athadona* has rounded foot corners, resembling the condition generally found in most Eubranchidae and Tergipedidae.

The radular morphology of each species is also specific. *Flabellina abei* and *F.* ***amabilis*** have similar numbers of rows of teeth (15 vs. 13–17, respectively), but the two species differ markedly in rachidian tooth morphology, especially in the central cusp; the cusp is long and thin in *F. abei* and long and wide in *F.* ***amabilis.*** The lateral teeth of *F. abei* have many more medial denticles, although the basic sickle shape is similar in both. The character of 19–22 teeth rows in *F. athadona* is different from the previous two species, as is the rachidian tooth morphology and the smaller number of lateral denticles (4 or 5 only).

The specific differences between the three congeners also extend to the reproductive systems. *Flabellina athadona* differs in the shape of the penis, which consists of a folded and rolled extension of the preputial lining (false penis; Baba, 1987b) and also possesses a vestibular or preputial gland located at the posterior end of the preputium (personal observation; Baba, 1987b). *Flabellina abei* possesses a short conical penis distal to a short thick prostatic vas deferens and a common genital atrium or vestibule. The penis is also conical in *F.* ***amabilis***, but the vas deferens is considerably longer than that which Baba (1987a) figured for *F. abei. Flabellina* ***amabilis*** also has separate male and female gonoporal openings contained in a common gonopore. All three species possess a saccular bursa copulatrix with a long narrow duct, but the insertion points into the nidamental duct differ among the species. The receptaculum seminis of *F. athadona* is semi-serial, while it is completely serial in *F.* ***amabilis.*** Baba (1987b) did not describe or figure either the oviduct or receptaculum for *F. abei.*

Of the other flabellinids known from the Sea of Japan, *Flabellina* ***amabilis*** differs from *F. orientalis* (Volodchenko, 1941) on the basis of radular morphology (the number of teeth rows, and the shape and denticulation pattern of rachidian and lateral teeth), the shape of the rhinophores, the foot, and the possession of nonclustered cerata. *Flabellina* ***amabilis*** can be distinguished from *F. verrucosa* (Sars, 1829) reported from the Sea of Japan (Volodchenko, 1955), on the basis of radular and penial morphology, as well as body coloration. *Flabellina alderi* (Adams, 1861), described from specimens collected off Matsumae, Hokkaido (Strait of Tsugaru), was cited by Bergh (1885) and listed by Marcus (1961) as an uncertain species. Based on the cursory Latin description given by Adams (1861) of the general body shape and coloration, there are similarities between *F. alderi* and *F.* ***amabilis***. However, the two appear to differ in the morphology and coloration of the oral tentacles and rhinophores.

When compared with the other described flabellinid species, *Flabellina* ***amabilis*** most closely resembles *F. gracilis* (Alder & Hancock, 1844). The general body morphology and ornamentation, with the opaque white stripes on the oral tentacles, rhinophores, and tail, are similar in both species, as is the possession of a conical penis. The animals differ externally, however, in that *F. gracilis* has longer, acutely pointed foot corners, an anus beneath the first row of the second ceratal cluster, and a gonopore located below the posterior half of the first cluster. Although both species have similar numbers of radular teeth rows, the rachidian teeth of *F. gracilis* are broader (length to width ratio), while the central cusp is shorter and narrower. Differences are also found in the reproductive anatomy of the two species, both in the shape of the receptacula seminis and in the length and number of coils of the ampulla.

It is interesting to note that these two species, *Flabellina* ***amabilis*** and *F. gracilis,* appear to occupy similar ecological niches in their respective distributional ranges. Both species are stenotrophic in their prey selection and are found associated with species of the athecate hydroid *Eudendrium* (Kuzirian, 1979). They share the same preferences for hard rocky substrates. They also have similar seasonal occurrences and lay identical undulating coiled egg masses (type B; Hurst, 1967), which they deposit around and among the branches of their hydroid prey.

Flabellina ***amabilis*** is found sympatrically with *F. athadona* in Oshoro Bay. Because the two species are often difficult to distinguish as preserved specimens, identification of living animals is preferable for ecological investigations. Details on the ecological relationships between these two species will be reported in a later paper.

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